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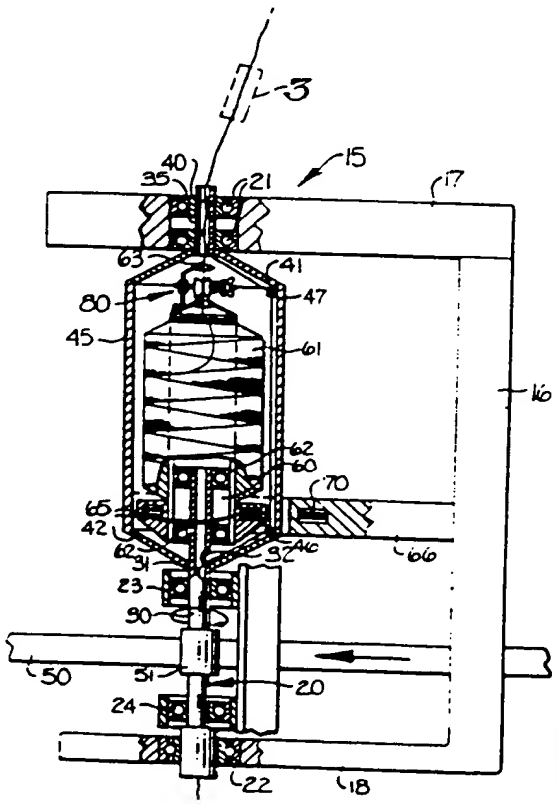
(54) Title: APPARATUS AND METHOD FOR FORMING ELASTIC CORESPUN YARN

(57) Abstract

A spindle (20) is mounted to a frame (16) for rotation about the spindle axis. A core yarn package (61) of elastic core yarn (63) is held stationary on the spindle. Elastic core yarn (63) is withdrawn from the core yarn package (61) in a direction substantially along the spindle longitudinal axis. A nonelastic covering yarn (12) is drawn from a supply package, through the spindle (20) and along a confined yarn guide passageway (45, 46, 47) from the spindle guide passageway outwardly, upwardly and inwardly around and in spaced relation to the core yarn package for confining and guiding the covering yarn (12), and then into wrapping engagement with the withdrawn core yarn (63) to form a corespun yarn.



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APPARATUS AND METHOD FOR FORMING ELASTIC CORESPUN YARN

Field of the Invention

This invention relates to an apparatus and method for forming an elastic corespun yarn and more particularly to an apparatus and method for forming an elastic corespun yarn wherein a nonelastic covering yarn is drawn into wrapping engagement with the elastic core yarn for forming an elastic corespun yarn.

Background of the Invention

In many types of conventional wrapping apparatus for forming ar elastic corespun yarn, and in some two-for-one twisting apparatus, a hollow rotating spindle carries a supply package of nylon or other nonelastic covering yarn. An elastic core yarn such as spandex is passed through the center of the hollow spindle. The nylon covering yarn is unwound from the rotating supply package and is wrapped around the elastic core yarn to form an elastic corespun yarn. The uninterrupted length of elastic corespun yarn formed by this apparatus is limited by the size of the covering yarn supply package which can be carried by the rotating spindle. Because the cov ring yarn is used at a much faster rate than the core yarn, the winding apparatus must frequently be stopped to replenish the covering yarn supply package.

It has been proposed to provide a longer run of elastic corespun yarn by providing a wrapping apparatus where the covering yarn is drawn from a stationary yarn supply package into surrounding, ballooning relationship with a package of elastic core yarn carried by a fixed spindle. The elastic core yarn is metered from the package and the covering yarn is wound in wrapping engagement with the drawn core yarn.

For example, in United States Patent Nos. 2,737,773 and 4,309,867 to Clarkson and Ichikawa, respectively, the elastic core yarn is metered from a stationary supply package carried by a spindle. The elastic core yarn then is wrapped by the covering yarn. In United States Patent No. 4,509,320 to Maeda, a core yarn package of elastic yarn is carried by a driven spindle while the drawn elastic core yarn is wrapped by the covering yarn. A tension device provides the proper amount of tension to the elastic core yarn during wrapping.

The aforementioned apparatus provide for the production of larger units of corespun yarn with the attendant fewer winding stops necessary for replenishing a yarn supply package of the winding yarn. These apparatus, however, mandate operation at a decreased winding speed. Operation of the apparatus at higher spindle speeds increases the centrifugal force of the covering yarn causing the covering yarn to break. Operation of this type of apparatus at high spindle speeds is also limited because of the weight of the elastic core yarn unwinding mechanism.

Summary of the Invention

It is therefore an object of this invention to provide an apparatus and method for forming an elastic corespun yarn and which overcomes the aforementioned deficiencies of the prior art. Another object of this invention is to provide an apparatus and method for forming an elastic corespun yarn wherein a

nonelastic covering yarn is drawn from a supply package through the spindle and radially outwardly, upwardly and inwardly in a confined passage around and in spaced relation to a core yarn package supported by the spindle and then into wrapping engagement with the core yarn.

These and other objects and advantages of the present invention are accomplished by an apparatus and method for forming an elastic corespun yarn which is characterized by having increased winding speed and the ability to produce a larger package of corespun yarn so that a covering yarn supply package of any desired size may be utilized to produce elastic corespun yarn of a length limited only by the length of the elastic core yarn which can be supplied by the core yarn package. The covering yarn is confined in its path of travel around the core yarn package thereby preventing breakage due to centrifugal force and air resistance even at very high spindle speeds.

The apparatus includes a spindle holding frame having a spindle rotatably mounted thereon for rotation about a longitudinal axis. Drive means is operatively connected to the spindle for rotating the spindle about the axis. A core yarn package of relatively elastic yarn is carried by the spindle coaxially therewith. The core yarn package is held stationary relative to the spindle as the spindle rotates.

A guide passageway is defined in the lower portion of the spindle along the longitudinal axis thereof for a predetermined distance upwardly from the lower end of the spindle and radially outwardly to the periphery of the spindle. Yarn confinement means in the form of a cylinder having eyelets positioned therein is mounted on the spindle for rotation therewith and defines a confined yarn guide passageway from the spindle guide passageway outwardly, upwardly

and inwardly around and in spaced relation to a core yarn package supported on the core yarn support means for confining and guiding the covering yarn from the longitudinal axis of the spindle outwardly, upwardly and inwardly of the core yarn package.

Means is provided for withdrawing an elastic core yarn from the core yarn package supported by the spindle and for feeding the elastic core yarn in a direction substantially along the spindle longitudinal axis thereof. Means is also included for withdrawing a nonelastic covering yarn from a supply package, through the spindle and yarn confinement means guide passageways, and into wrapping engagement with the elastic core yarn for forming an elastic corespun yarn.

Brief Description of the Drawings

Other objects and advantages will appear as the description proceeds when taken in connection with the accompanying drawings in which --

Figure 1 is a fragmentary elevational view of the apparatus for forming a corespun yarn in accordance with the present invention;

Figure 2 is an enlarged fragmentary sectional view of the spindle in accordance with the present invention;

Figure 3 is an enlarged partial sectional view of the dotted line area marked 3 in Figure 2 and showing in detail the formed corespun yarn; and

Figure 4 is an enlarged vertical sectional view of the tension control device shown in Figure 2.

Detailed Description of the Preferred Embodiment

Referring now to the drawings, Figure 1 illustrates the apparatus of the present invention for forming an elastic corespun yarn, broadly indicated at C, wherein the apparatus is characterized by having an increased winding speed and the ability to produce a larger package of corespun yarn C. As shown in greater detail in Figure 2, the apparatus includes a spindle

assembly, broadly indicated at 15, which includes a spindle holding frame 16 with respective upper and lower cantilevered arms 17, 18. It is to be understood that a plurality of these spindle assemblies 15 are provided in side-by-side relationship in two full rows along the outside of an elastic yarn spindle wrapping machine.

A spindle, broadly indicated at 20, is rotatively mounted in the cantilevered arms 17, 18 by means of respective upper and lower bearing assemblies 21, 22 so that the spindle defines a longitudinal axis extending through both of the arms. Additional bearing assemblies 23, 24 rotatively support the lower portion of the spindle 20. The spindle 20 includes a lower spindle portion 30 mounted for rotation in the three sets of bearings 22, 23 and 24. The lower spindle portion 30 is hollow and includes a lower guide passageway 31 defining an axial passageway extending in the lower portion of the spindle, and an exit orifice or passageway 32 exiting radially from the spindle 20. An upper hollow spindle portion 35 is mounted for rotation in the upper cantilevered arm 17 by the upper bearing assembly 21 therein. The upper spindle portion 35 includes an upper guide passageway 40 extending coaxially through the top portion and exiting coaxially therefrom.

As illustrated in Figure 2, the medial portion of the spindle 20 includes respective top and bottom conical caps 41, 42 and a cylinder 45 is secured to the caps 41, 42 and coaxially therebetween so that as the spindle 20 rotates, the cylinder 45 rotates therewith. The cylinder 45 is positioned so that the radially extending exit orifice 32 is positioned within the confines of the cylinder 45. A first eyelet 46 is fixed inside the cylinder 45 where the lower cap 41 and cylinder 45 connect. A second eyelet 47 is fixed above the first eyelet 46. Both eyelets 46, 47 and the

cylinder 45 define a confined yarn guide passageway from the spindle guide passageway 31 and orifice 32 outwardly, upwardly and inwardly in the cylinder 45. Additionally, a tube (not shown) can extend between the exit orifice 32 and the first eyelet 46, between the eyelets 46, 47 and between eyelet 47 and the upper guide passageway 40 to facilitate threading by vacuum drawing instead of by conventional mechanical threading apparatus. Preferably, the cylinder 45 is made from a strong, lightweight material, such as titanium or a composite, lightweight material such as carbon fiber.

Drive means, in the form of an endless drive belt 50, is operatively connected to the spindle 20 for rotating the spindle 20 about the longitudinal axis. The belt 50 engages a cylindrical drive hub 51 positioned on the lower spindle portion 30. As the belt 50 moves at a high speed, it engages the lower spindle portion 30 to rotate the spindle at a very high RPM - as much as 50,000 to 60,000 RPM.

A yarn package support carrier 60 is positioned on the upper part of the lower spindle portion 30 and extends above the radially extending exit orifice 32. The support carrier 60 is inside the confines of the cylinder 45 for supporting, in substantial axial alignment with the spindle 20, a core yarn package 61 of relatively elastic yarn 63, preferably spandex. The yarn package support carrier 60 is provided with spaced upper and lower bearings 62 which receive and support the core yarn package 61 so that the elastic core yarn 63 may be withdrawn therefrom. The yarn package support carrier 60 includes a permanent magnet 65 positioned therewithin. A cantilevered support arm 66 is provided adjacent the outer perimeter of the cylinder 45 and has a free end partially surrounding the cylinder 45. A magnet 70 (Figure 2), which can be a permanent magnet or an electromagnet, is fixed in the arm 66 and adjacent the

perimeter of the cylinder 45. The magnet 70 provides an attracting magnetic force for attracting the permanent magnet 65 positioned on the yarn package support carrier 60 and for holding the yarn package support carrier 60 stationary relative to the spindle 20 as the spindle 20 rotates.

When the core yarn package 61 is positioned on the yarn package support carrier 60, in the manner illustrated, a tension control device, broadly indicated at 80, is positioned on the upper end of the spool of the core yarn package 61 to provide the required amount of tension to the core yarn 63 as it is drawn off the yarn package 61. Various types of conventional tension control, such as the illustrated disc type, can be used. As illustrated in greater detail in Figure 4, the illustrated tension control device 80 includes a support bracket 81 fixed at its lower end on the upper portion of a thrust bearing 83 and positioned at the lower portion of the housing. The thrust bearing is dimensioned for receipt onto the spool 61a of the yarn package 61. The thrust bearing 83 allows the tension device 80 to rotate as needed during the wrapping operation of the covering yarn 12 onto the core yarn 63. The housing 81 includes upper and lower grommets 86, 87 for allowing the core yarn 63 to pass therethrough with minimal friction. Positioned in the housing are a pair of discs 90, 91 engaging each other and supported by a threaded shaft 92 extending through the housing 81. A yarn passageway 93 extends between the discs 90, 91 and the shaft 92 for allowing the core yarn 63 to pass therebetween. A spring 95 is positioned between one of the discs and a wing nut 96, and pressure may be increased or decreased against the other disc by turning the wing nut 96 positioned on the threaded shaft 92. Pressure is increased by turning the wing nut 96 inward to increase spring pressure against the discs, thus resulting in increased tension

on the core yarn drawn therebetween. When the wing nut 96 is turned outward, spring pressure is decreased resulting in a decreased tension on the core yarn. If a magnetic tensioner is used, tension automatically can be adjusted. With the illustrated embodiment, an opening (not shown) can be provided in the cylinder wall for allowing an operator to manually adjust tension.

A lower set of rolls 98 are positioned beneath the spindle 20 for aiding in guiding a covering yarn 63 upwardly through the lower guide passageway 31. An upper set of rolls 99 working with a take-up roll 100 draw the formed corespun yarn C.

Method of Operation

Initially, a covering yarn is threaded through the lower set of rolls 98 into the lower guide passageway 31, outward into the cylinder 45 and through the eyelets 46, 47. When a tube is used as described above, vacuum may be used for threading the yarn. Otherwise, a mechanical threading apparatus is used. The covering yarn 12 is drawn in wrapping engagement with the core yarn 63 and the resulting corespun yarn C is drawn upward through the upper guide passageway 40 to the upper set of draft rolls 99 where it is wound on the core of a take-up roll 100.

The spindle 20 is rotated at a high RPM ranging from 50,000 to 60,000 RPM. The upper set of rolls 99 pull the formed corespun yarn C upwardly while pulling the core yarn 63 and the covering yarn 12 from their respective yarn packages 11, 61. As the spindle 20 rotates, the covering yarn 12 is centrifugally forced against the inside wall of the cylinder. During high speed spindle operation, the cylinder 45 and eyelets 46, 47 guide the covering yarn 12 to a restricted diameter for preventing breakage of the covering yarn. The covering yarn rotates with the cylinder and is forced into wrapping engagement with

the core yarn to form the resulting cor spun yarn (Figure 3). Additionally, the magnet 70 is energized for preventing rotation of the yarn package support carrier 60 having the core yarn package supported thereon.

The invention offers several benefits over other prior art apparatus. Because the covering yarn package is not carried by the spindle, longer runs of the apparatus can be accomplished without changing the yarn packages. Additionally, the cylinder in which the covering yarn is confined during its centrifugal, advance upward prevents breakage of the covering yarn during high speed spindle operation.

In the drawing and specification there has been set forth the best mode presently contemplated for the practice of the present invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

CLAIMS:

1. An apparatus for forming an elastic corespun yarn having

a spindle mounted for rotation about a longitudinal, vertically oriented axis and drive means operatively connected to said spindle for rotating said spindle about said vertical axis and being characterized by having

means for supporting a package of relatively elastic core yarn in vertical coaxial alignment of said spindle and stationary relative to said spindle as said spindle rotates,

means for withdrawing and feeding the elastic core yarn along a path of travel substantially along the longitudinal axis of said spindle,

means for supporting a package of a relatively inelastic covering yarn in spaced relation to said spindle and for delivering the covering yarn to said spindle,

confinement means supported by said spindle and enclosing said core yarn support means and any core yarn package supported thereon, and wherein said confinement means is a cylindrical member and aligned longitudinally along said vertically oriented axis,

means defining a confined yarn guide passageway for confining and guiding the covering yarn into wrapping engagement with the core yarn being fed along a predetermined path of travel, said yarn confining and guiding means defining a first yarn guide passageway portion along the longitudinal axis of the lower portion of said spindle and extending radially outwardly of said spindle into said cylindrical member, means carried by said cylindrical member in the interior of the cylindrical member for guiding the yarn from said first yarn guide passageway portion outward and upward along the interior surface of the cylindrical member and in spaced relation to a core

yarn package support d on said support means and then inward to a location above the core yarn package to the longitudinal axis of said spindle above the core yarn package, whereby a covering yarn supply package of any desired size may be utilized to produce elastic corespun yarn of a length limited only by the length of elastic core yarn which can be supplied by the core yarn package, and whereby the covering yarn is confined in its path of travel around the core yarn package thereby preventing breakage due to centrifugal force and air resistance even at very high spindle speeds.

2. Apparatus according to Claim 1 wherein said cylindrical member withstands centrifugal force at spindle speeds in excess of 50,000 RPM.

3. Apparatus as claimed in Claim 1 wherein said cylindrical member has top and bottom end caps mounted on said spindle for rotation therewith and closing the top and bottom ends of said cylindrical member.

4. An apparatus for forming an elastic corespun yarn having a spindle holding frame and a spindle rotatably mounted in vertical orientation on said frame for rotation about a longitudinal axis, drive means operatively connected to said spindle for rotating said spindle about said axis and being characterized by means carried by said spindle for supporting a core yarn package of relatively elastic yarn on said spindle in vertical axial alignment therewith,

means for holding said core yarn package support means stationary relative to said spindle as said spindle rotates,

confinement means supported by said spindle and rotatable therewith, and enclosing said core yarn

support means and any core yarn package supported thereon, and wherein said confinement means is a cylindrical member and aligned longitudinally along said vertically oriented axis,

tension application means positioned within said cylindrical member for receiving said core yarn after withdrawal from said core yarn package and applying tension to the core yarn,

means defining a first yarn guide passageway in the lower portion of said spindle along the longitudinal axis thereof for a predetermined distance upwardly from the lower end of said spindle and radially outwardly to the periphery of said spindle into said cylindrical member, and means carried by said cylindrical member in the interior of the cylindrical member for guiding the yarn from said first yarn guide passageway portion outward and upward along the interior surface of the cylindrical member and in spaced relation to a core yarn package supported on said support means and then inward to a location above the core yarn package to the longitudinal axis of said spindle above the core yarn package,

means for withdrawing an elastic core yarn from a core yarn package supported by said spindle and for feeding the elastic core yarn through said tension application means and in a direction substantially along the spindle longitudinal axis thereof,

means for drawing a nonelastic covering yarn from a supply package through said spindle and along said guide means of said cylindrical member into wrapping engagement with said elastic core yarn for forming an elastic corespun yarn,

whereby a covering yarn supply package of any desired size may be utilized to produce elastic corespun yarn of a length limited only by the length of elastic core yarn which can be supplied by the core yarn package, and whereby the covering yarn is confined

in its path of travel around the core yarn package thereby preventing breakage due to centrifugal force and air resistance even at very high spindle speeds.

5. The apparatus as claimed in Claim 4 wherein said drive means includes an endless belt operatively connected to said spindle for rotating said spindle as said belt is moved.

6. The apparatus as claimed in Claim 4 wherein said means for withdrawing an elastic core yarn from a core yarn package includes a plurality of rolls.

7. The apparatus as claimed in Claim 4 wherein said means for drawing a nonelastic covering yarn through said spindle and yarn confinement means guide passageways includes a plurality of rolls.

8. The apparatus as claimed in Claim 4 wherein said yarn confinement means mounted on said spindle for rotation therewith includes eyelets mounted within the cylindrical member.

9. The apparatus as claimed in Claim 8 wherein said cylindrical member is formed of a lightweight material capable of withstanding centrifugal force at spindle speeds in excess of 50,000 RPM.

10. The apparatus as claimed in Claim 4 including means for applying tension to the elastic core yarn before it is wrapped by the covering yarn.

11. The apparatus as claimed in Claim 4 wherein said means for holding said core yarn package support means stationary relative to said spindle as said spindle rotates includes a magnet positioned on

said core yarn package support means and magnet m ans for providing a magnetic field of force for attracting said magnet positioned on said core yarn package support means and for holding said core yarn package support means stationary.

12. A method for forming an elastic corespun yarn which is characterized by the steps of

supporting a package of relatively elastic core yarn in a vertical orientation along the longitudinal axis of a spindle,

rotating the spindle while maintaining the package of relatively elastic corespun yarn stationary relative to the rotating spindle and withdrawing a core yarn from the package and feeding the core yarn substantially along the longitudinal axis of the rotating spindle,

applying tension to the core yarn after it is withdrawn from the core yarn package,

supporting a package of relatively inelastic covering yarn at a location remote from the rotating spindle while withdrawing the covering yarn from the package and delivering a running length thereof to the lower end of the rotating spindle, and

guiding the covering yarn initially along the longitudinal axis of the rotating spindle and then axially outwardly thereof to beyond the core yarn package, upwardly to a point above the core yarn package and inwardly into wrapping engagement with the core yarn being fed along the longitudinal axis of the rotating spindle while confining the covering yarn within a cylindrical member mounted coaxially with the spindle to prevent breakage thereof by air resistance or centrifugal force.

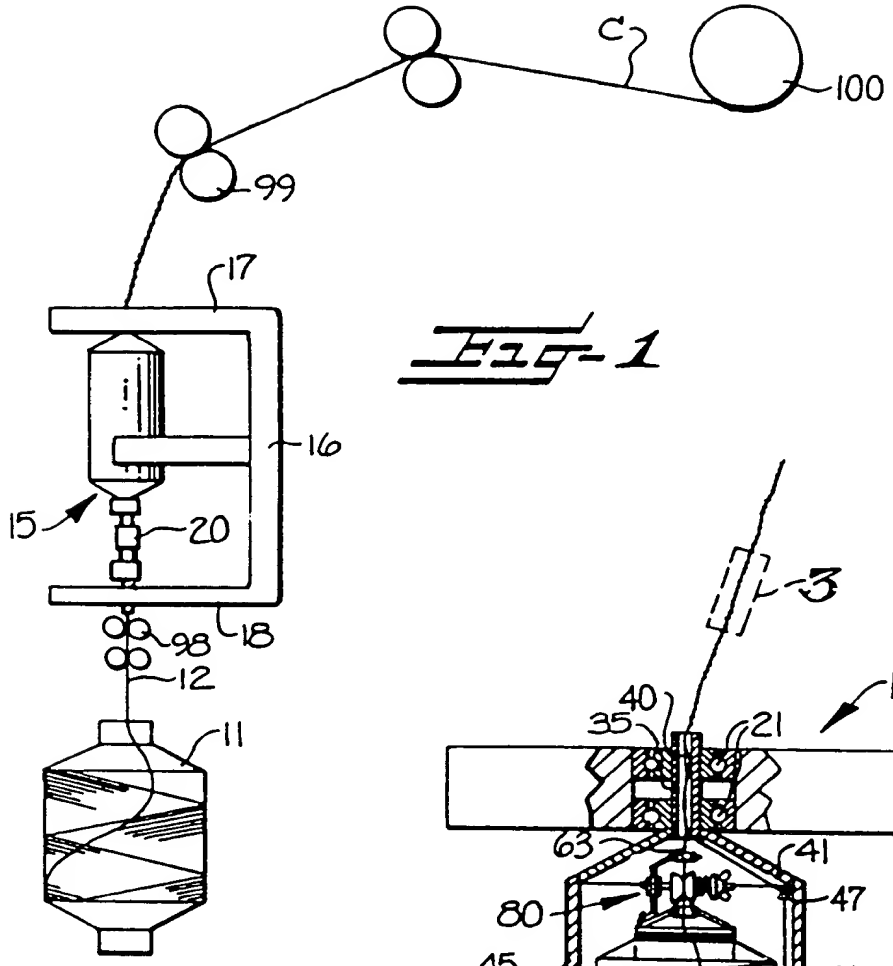

Fig-1

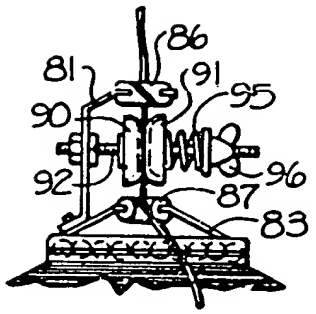

Fig-4

Fig-3

Fig-2

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/06804

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 D02G3/28; D02G3/32

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	D02G

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
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A	EP,A,0 310 848 (FILLATTICE) 12 April 1989 see column 2, line 47 - line 50	11

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* Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
14 JANUARY 1992	17. 02. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	RAYBOULD B.D.J.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9106804 SA 52087

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 14/01/92
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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